

REMARKS

Claims 1-19 were all the claims pending in the application when the office action was mailed. Claims 1-13 were elected without traverse and claims 14-19 are withdrawn from consideration.

I. Preliminary Matters. New Claim 20 has been added for consideration. Basis is provided by page 16, lines 33, to page 17, line 9, and page 17, lines 15-16. No new matter is added.

An Information Disclosure Statement submitting certain publications for consideration is also filed concurrently herewith.

II. Summary of the Office Action. In the office action, claims 1-13 were rejected:

(a) under 35 USC 112, first paragraph, for lacking an enabling disclosure for microbes beyond those listed in the specification;

(b) under 35 USC 112, first paragraph, for failing to comply with the written description requirement, for not providing guidance to select the appropriate microbes;

(c) under 35 USC 112, second paragraph, for being indefinite for not pointing out and distinctly claiming the scope of the microbes capable of doubling in mass; and

(d) under 35 USC 103(a) as obvious over Reith et al WO 01/74990 ("Reith"), because Reith discloses culturing in a combination of a closed system with an open system and the control of the inoculation of the photosynthetic micro-organism from the closed to the open system. The office action stated that, although Reith does not indicate that the micro-organism is capable of doubling in biomass within approximately 16 hours or less, the microbe having the property of doubling and the percentage inoculation does not appear to be any patentable difference, absent a showing of unexpected results or process steps.

III. Amendments. Claims 1, 9, 10, 12 and 13 have been amended in the supplying steps to delete "continuously, to supply sufficient carbon dioxide to said species and" or "continuously, to supply sufficient carbon dioxide to said microbes and." No new matter is added because page 20, lines 1 to 14, do not state that the carbon dioxide is supplied continuously. This amendment is made to avoid possible future arguments

that fluctuations or interruptions in the supplying of carbon dioxide, such as at night, would avoid the claims.

Claims 1, 9, 10, 12 and 13 have also been amended to change "closed system" to "one or more closed systems", to explicitly cover both single and multiple closed systems inoculating an open system. Basis is provided, for example, by page 15, lines 4-15; page 20, lines 32-34; and page 22, lines 21-22.

Claim 7 has been amended for grammar to delete the superfluous word "has."

Claim 10 has been amended to add "species of" in line 3 to provide antecedent basis for claim 20.

IV. Rejection of Claims 1-13 Under 35 USC 112, first paragraph, for lack of enablement.

It is respectfully submitted that the specification enables a person having ordinary skill in the art ("PHOSITA") to make and practice the invention, without undue experimentation, commensurate with the scope of the claims, because it would be well within the skill of PHOSITA to select the appropriate microbes.

Submitted herewith is an Information Disclosure Statement disclosing various representative publications in the field of the invention, which show that the

growth rates of microbes are fundamental characteristics of microbes that are well known to PHOSITA from such publications, so that PHOSITA would easily be able to select a microorganism capable of doubling in biomass in 16 hours or less.

As can be seen from Stein, page 19, doubling time, generation time or division time are the characteristic time for cells in a culture to divide.

Baars shows 350 generation times for 50 species under various conditions. Doubling of biomass in approximately 16 hours, or a generation time of 16 hours, equates to a doubling rate of 1.5 doublings per day, as explained on the third paragraph and bottom paragraph of page 138 of Baars (Generation time in doublings per day $G = 24/\text{generation time in hours} = 24/16 = 1.5$ doublings per day). Page 19, lines 3-4 and 15-16, of the specification also state that a doubling time of 16 hours is equal to one and a half doublings per day.

Eppley provides growth rates for many species, expressed in doublings per day. Note that Fig. 1 of Eppley shows that many species have a growth rate that exceeds 1.5 doublings per day (doubling time of 16 hours or less) at temperatures of 20 degrees Celsius. Fig. 2

shows that all 5 algae exceed 1.5 doublings per day at some temperature.

Johansen, et al show growth rates mostly exceeding 1.5 doublings per day for the species and strains listed in table 2.

Brand, et al shows divisions per day (doublings per day) for 22 species of marine phytoplankton.

Gedde shows growth rates of *Thalassiosira andamanica* in divisions (or doublings) per day, at different temperatures (see Fig. 17).

Sarthou, et al, shows maximum growth rates for various microbes in Fig. 1.

Lourenco et al shows growth rates in divisions (doublings) per day in Table 1.

Strzepek, et al shows growth rates in units of per day on page 110.

Stramski, et al shows growth rates in units of per day in Fig. 2.

Thompson shows growth rates in units of per day in Fig. 1.

Thompson, et al (1991) shows growth rates in units of per day in Fig. 1.

Thompson, et al (1992) shows growth rates in units of per day in Fig. 1.

There are many, many other publications providing growth rates for various microbes under various conditions.

Accordingly, it is respectfully submitted that it would be well within the skill of PHOSITA to select a species of photosynthetic microbe capable of doubling in biomass in approximately 16 hours or less, without undue experimentation. Thus, the rejection of claims 1-13 for failure to provide enablement for microbes, other than those mentioned in the specification, must be withdrawn.

V. Rejection of Claims 1-13 Under 35 USC 112, first paragraph, for written description. For the reasons stated above, it is clear that the specification reasonably conveys to one skilled in the art that the inventors, at the time the application was filed, had possession of the claimed invention with respect to the microbes, because the public is informed of the bounds of the invention. The properties which impart the specific capability of doubling in biomass are well known in the art, as shown above, so that the rejection for lack of a written description must be withdrawn.

VI. Rejection of Claims 1-13 Under 35 USC 112, second paragraph, for indefiniteness. For the reasons stated above, it is clear that a skilled artisan

(PHOSITA) could indeed discern the boundaries of the claim, based on the claim language and the specification, within the scope of the claimed "capable of doubling in biomass", so that the rejection for indefiniteness must be withdrawn.

VII. Rejection of Claims 1-13 Under 35 USC 103(a).

The office action stated that "The reference [Reith] does not indicate that the micro [sic] is capable of doubling in biomass within approximately 16 hours or less but does teach the first step of culturing in a combination of a closed system with an open system, see Figure 2 and the control of the inoculation of the photosynthetic micro-organism from the closed system to the open system see page 5 and Figure 1. Applicant has not shown any patentable difference(s) over the art of record with respect to the requirements of the claimed limitations pertaining to (a) microbe having property of doubling and the percentage inoculation which does not appear to be any patentable difference absent a showing of unexpected results or process steps." Thus, the office action found that Reith does not teach doubling in biomass within 16 hours, but that the doubling and percentage of inoculation are not patentable

differences, "absent a showing of unexpected results or process steps."

To the same effect, the office action stated "If there are any differences with respect to the claimed subject matter and the general knowledge pertaining to the art in the area, that these differences would have been prima facie obvious to one of ordinary skilled [sic] in the pertinent art whether it was based on the art of record or claimed subject would have been obvious for the 'combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results'; since the reference [Reith] teaches various micro-organism for culturing algae having a high productivity and biomass by controlling the growth rate and flow from the closed to open systems which renders the instant claims obvious absent a showing of unexpected results."

Thus, the office action rejected the claims as obvious because the limitations of doubling in biomass in 16 hours or less and inoculating at least 5% of carrying capacity would have been a "combination of familiar elements according to known methods", absent a showing of "unexpected results."

However, it is crystal clear that the differences of doubling in biomass in 16 hours or less, and inoculating at least 5% of carrying capacity, do indeed provide unexpected results, and certainly do "more than yield predictable results." Indeed, these differences solve the long felt but unmet need for a solution to the decades-long problem of contamination in open ponds.

Reith specifically states "it is important, in order to achieve the highest possible algal productivity, to maintain the biomass density in the system as accurately as possible at an optimal, constant value, in order to allow the conversion of the incident light into algal biomass to proceed as efficiently as possible." Page 5, lines 6-9. Reith further states "As the biomass density must remain optimal and the water depth must not increase, the elements of the system will preferably show an exponential increase in surface area. The increase in surface area can be obtained by an increase in the number of elements in the downstream direction. Instead, an increase in surface area can be obtained by an increase in the reactor volume in the downstream direction. The volume increase is achieved by additional culture medium or waste water containing nutrients being fed in at two or more locations, thereby

maintaining the algae concentration at a constant level." Page 5, lines 11-18.

It is clear that Reith teaches that the algae concentration must be maintained at a constant, optimal level, by exponentially increasing the surface area through increasing the number of downstream elements, or through increasing the reactor volume by adding culture medium or waste water containing nutrients.

In stark contrast, as explained on page 18, line 33, to page 19, line 22, the present invention requires that the algal concentration change from an original 5% of carrying capacity, to 90% of carrying capacity, without increasing surface area.

Reith clearly teaches against an algal concentration varying from 5% to 90% of carrying capacity (without an exponentially increasing surface area), so that Reith clearly teaches against the present invention, and the present invention therefore clearly is not obvious from Reith.

Indeed, because Reith undoubtedly teaches the necessity to maintain a constant optimal algal concentration through exponentially increasing surface area, it is a surprising, unpredictable and unexpected result that high productivity can be achieved by exactly

the opposite - the present invention's highly varying concentration (from 5% to 90% within 5 days) without exponentially increasing surface area. Further, avoiding the need for exponentially increasing surface area provides a substantial advantage to the present invention because much less land is required, thus unpredictably increasing productivity per unit of land.

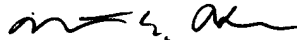
As described on page 18, line 33, to page 19, line 32, the surprising, unexpected and unpredicted higher productivity from the present invention's highly varying concentration (from 5% to 90% within 5 days) is the key to the present invention's solving the decades-long contamination problem of open systems (described on page 9, line 25, to page 11, line 32) by dominating any potential contaminants.

Therefore, the obviousness rejection must be withdrawn because the present invention's highly varying algal concentration (5% to 90% in 5 days due to the doubling of biomass in 16 hours and 5% inoculation) are directly contrary to Reith's teaching of constant algal concentration and exponentially increasing surface area, thereby achieving the surprising, unexpected and unpredictable result of overcoming the decades-long contamination problem of open ponds.

There are other substantial differences between Reith and the present invention. For example, Reith specifically states "The series of connected open reactors numbers at least three reactors, preferably at least four reactors." Page 4, lines 7-8.

VIII. Conclusion. In view of the above, it is respectfully submitted that this application is now in condition for allowance, and an early action to that effect is earnestly solicited. If the claims would be in condition for allowance except for minor revisions, Applicant's attorney courteously invites a telephone interview initiated by the Examiner so that such revisions can be effected by Examiner's amendment.

Respectfully submitted,



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